HX 20 Bypass Piping Stress Analyses

HX20 will be bypassed by connecting 6in discharge line from turbines 6A/6B to 8in low pressure line. Stresses in both 6in and 8in lines were calculated with and without the bypass connection. CAEPIPE software was used to perform the analysis. Calculations are based on ASME code B31.3 (2002) for process piping.

Figure 1 shows an isometric view of the piping layout model used in stress analysis with the bypass connection.. Peak stresses are summarized in Table 1. Calculations were done at 78 psi (burst disk pressure) psi and -450 F temperature. Peak stresses at bypass connection ends are summerized in Table 2

Table 1: Peak Stresses (psi)

Sustained Stresses		Expansion Stresses		Location
Calculated	Allowable	Calculated	Allowable	
1456	20000	33900	48544	Turbine 6A/6B discharge lines (node 470)
12068	20000	5268	37932	Far end at the elbow with flexline (n 30B)

Both points in Table 1 are located at the part of the piping that already exits. Stresses at these points do not change with or without the addition of the bypass connection.

Table 2: Peak Stresses at the Bypass Connection

Sustained Stresses		Expansion Stresses		Location
Calculated	Allowable	Calculated	Allowable	
1903	20000	5583	48097	Bypass joint at node 100
1655	20000	4552	48519	Bypass joint at node 101

Bypass piping has a factor of safety higher than 6. Allowable sustained stresses under ASME code are 20,000 psi for 304 SS. Since tensile properties of 304 SS improve at lower temperatures, factor of safety will be higher under operating conditions. Table 3 summarizes the tensile properties of 304 SS. Stresses at room temperature are summarized in Table 4 and 5.

Table 3: Tensile Properties of SS 304[1]

Ultimate Tensile Strength (psi)		Yield Strength (psi)	
295 K	4 K	295 K	4 K
98, 400	242, 200	56, 900	77, 900

[1] Tensile and Impact Properties of Selected Materials From 20 to 300 K by K. A. Warren and R. P. Reed. NBS Monograph 63, Issued June 28, 1963.

Table 4: Peak Stresses at Room Temperature (psi)

Sustained Stresses		Expansion Stresses		Location
Calculated	Allowable	Calculated	Allowable	
1456	20000	1717	48544	Turbine 6A/6B discharge lines (470)
11253	20000	153	38747	Far end at the elbow with flexline (30B)

Table 5: Peak Stresses at the Bypass Connection at Room Temperature

Sustained Stresses		Expansion Stresses		Location
Calculated	Allowable	Calculated	Allowable	
1818	20000	764	48182	Bypass joint at node 100
1606	20000	395	48557	Bypass joint at node 101